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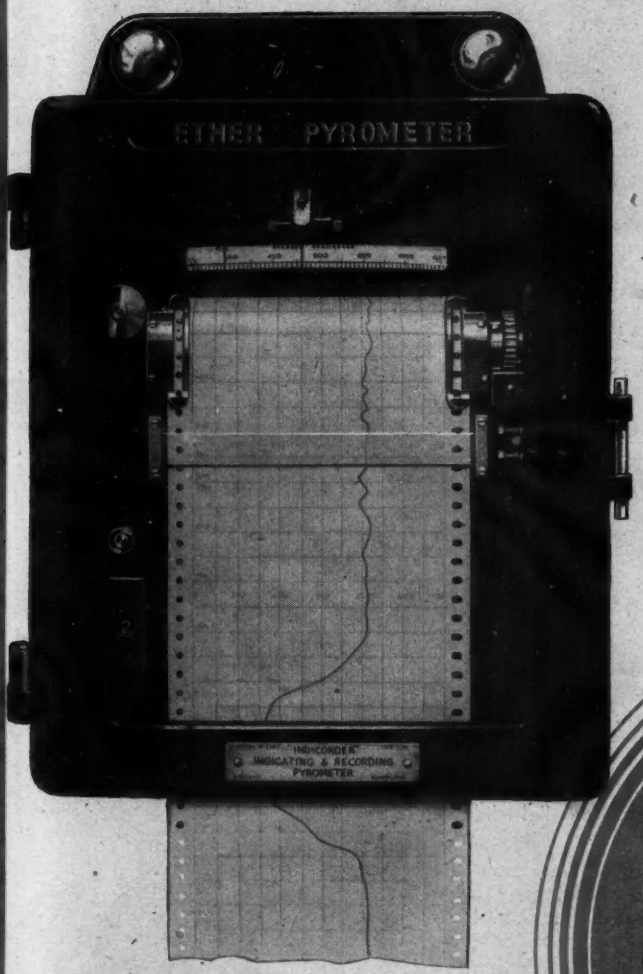

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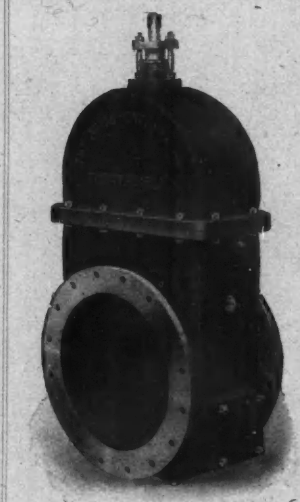

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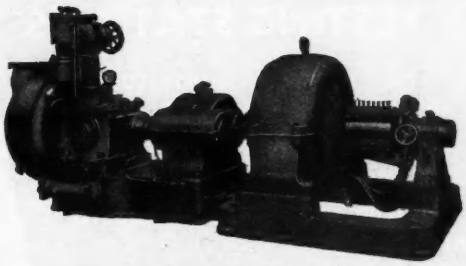

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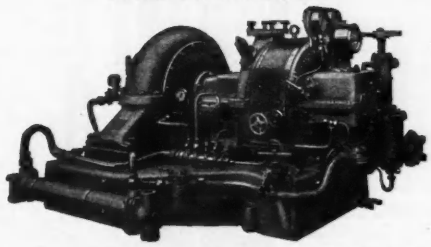

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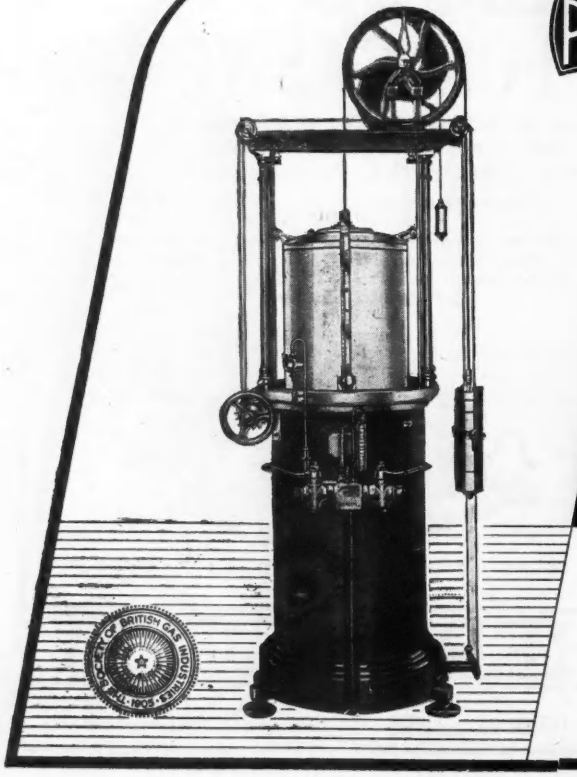

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GAS JOURNAL, OCT. 13, 1943

VOL. 242 95th YEAR No. 4195

EDITORIAL NOTES

"NON-BUNSEN" COOKING

COLD print does scant justice to the lecture-demonstration given by Mr. Dean Chandler to the Eastern District of the Southern Association at Gas Industry House last week, when he discussed gas flames and put forward his case for aeration entirely at the point of combustion—a case built up by years of investigation in the laboratory and on the district. We have followed this work with the keenest interest, and have taken the opportunity of commenting from time to time on its progress. Comparatively recently ("JOURNAL" of May 5) we outlined this progress in general terms, contrasting the so-called luminous flame with the bunsen flame, and offering a suggestion why the luminous flame has suffered from neglect when its advantages appear substantial. The modern "luminous" flame which is the starting-point of Mr. Chandler's contentions is not luminous; neither, of course, is it non-aerated. As we have mentioned before, Mr. Chandler advocates "neat" as a sufficiently appropriate designation, though objections to its use are not far to seek; on these we have also touched in our columns.

It was in May last that we explained that we had seen in unashamed detail a cooker of new design—a development of a model exhibited in Edinburgh in 1941 by Mr. Chandler on the occasion of his William Young Memorial Lecture to the North British Association—which obviates entirely the bunsen burner. Those present at the meeting of the Southern Association last week were able to see the new cooker and examine it for themselves. Neat-gas burners—we use "neat" in this note with neither praise nor condemnation, rather for the sake of convenience—are well known in their application to water heating and room warming. Total use of them on and in the cooker is, however, more of a radical departure, and it is to this aspect that we confine our present attention. As we have said, we have discussed the general problem of the neat-gas burner *vis-à-vis* the bunsen burner previously, from angles of both technicality and nomenclature. It often occurs to us that nomenclature is as flexible as the neat-gas burner, and no doubt Mr. A. P. Herbert, who seemingly objects strongly (*The Times*, Oct. 8) to private labels being attached to matters of public concern, would not, if his schooldays could be renewed, take kindly to a burner named after Bunsen, and would prefer a "neat-gas burner" to, say, a "Chandler burner," or even a "Murdoch burner." This rather by the way. The question of nomenclature, as was to be expected, cropped up in the discussion on Mr. Chandler's Paper. Our report of both Paper and discussion will be found on later pages.

Many years ago the late William Sugg, whose name is revered in the Gas Industry, made gas cookers fitted with neat-gas burners which he felt sure were free from the defects of more complicated burners—*i.e.*, of the bunsen type—in general use. Dr. Charles Carpenter, whose judgment has always commanded respect, remarked shortly before he died that for many years he had been puzzled by the adherence of the Gas Industry to non-luminous burners for cookers. Why did Sugg abandon the neat-gas burner? To this question Mr. Chandler expressed his conviction at the meeting last week that the demand created by publicity for the bunsen burner was too strong for Sugg to withstand alone; that he was forced into a policy opposed to his conviction; that he was in fact never converted to the view that it was right in principle to use bunsen burners for the purpose. To our mind, this question of creation of demand by publicity is of more than passing interest, and we should like to be able to strike some sort of balance between the demand created and the value of the instrument (the bunsen burner) essential to fulfil the demand. It seems to us that there could not have been anything fundamentally wrong with the bunsen burner as such, and that it was capable of fulfilling the necessary requirements as then understood. The question before us appears to be this: In present circumstances of gas supply, does the bunsen burner as applied to gas cooking lag, in performance, woefully behind the neat-gas burner? Is the neat-gas burner intrinsically more flexible, does it make maintenance easier and less costly, can its simplicity reduce the first cost of gas cookers? We know what answer Mr. Chandler, self-admitted an enthusiast of neat gas, would give. We were sorry that at the meeting of the Southern Association there were no vocal expressions from any representative of gas appliance manufacturers who, as their appliances testify, think well of and adhere to the bunsen burner.

On this question of flexibility Mr. Chandler had much to say in few words. At a coast town where he was staying recently there was a "temporary trouble" (we use this nomenclature not because we think it best fitted or most descriptive) at the gas-works which on a sudden resulted in changes in the quality of gas. The trouble lasted several days. Mr. Chandler telephoned for one of his neat-gas burners, which arrived promptly by post. He was able to compare its performance with bunsen burners which were giving trouble on a cooker "of well-known make extensively used in all parts of the country." The bunsen burners were erratic; efficiency of boiling was 39%. With the neat-gas burner there was no trouble; its efficiency was 48%. The gas supplied during the period was somewhat different from that normally supplied, but the neat-gas burner was accommodating. Q.E.D.? suggested Mr. Chandler.

Several who joined in the discussion said in effect that there is a "whale of a lot" (if our nomenclature may be pardoned) in Mr. Chandler's contentions, which are set out at the end of his Paper, concerning the merits of the neat-gas burner for cooking, and it was urged that it should be put to more extensive practical trial throughout the country. Disagreement was voiced on the matter of cooker design. Mr. Chandler maintains that the griller should not be an integral part of the hotplate, but should be an independent unit which can be connected to the cooker when it is required. Thereby, he argues, can be obtained better hotplate service accommodation and reduction of height of the hotplate from the floor. At the meeting he referred caustically to the degeneration of integral grillers into dirty and offensive components of the gas cooker. Our own view is that the griller should definitely be part of the cooker, and that if there is cause to be ashamed with the griller as we know it to-day, we should take steps to remove the cause rather than remove the griller. And we express the hope, which we have reason for believing is not a pious hope, that after the war the integral griller will come to be regarded, on grounds alike of speed, economy, and uniformity of grilling, as the finest part of the gas cooker.

Reverting, however, from the particular to the general, we feel that Mr. Chandler's work on neat gas is quite outstanding, that it is destined to benefit the Gas Industry in many ways and over a very wide field of gas usage, both domestic and industrial, and that the Paper given last week and published in our issue to-day commands respect and demands study.

U.S.A. FUEL FIGURES

WE publish in our issue to-day data obtained from several authoritative sources by Mr. S. J. Beale, whose name will be familiar to many of our readers, on the present facts regarding all forms of fuel, including electricity, in the United States of America. The statistics he sets out, as an addendum to rather than a comment on the Paper on gas fuel in post-war planning given by Mr. T. A. Tomlinson earlier in the year ("JOURNAL" of March 3, p. 277), will not only prove useful as a reliable reference, but will clarify comparison and stimulate thought, bearing in mind how different U.S.A. is from Britain in regard to climate, area, population, and national fuel resources. From time to time we are told that oil resources will come to a full stop in America in "*x*" years, "*x*" being a variable quantity, more often than not very small. Concurrently new fields are developed which are estimated to satisfy requirements for "*y*" years, again a variable quantity. And as a third factor we have a variable "*z*" representing current and likely future requirements. So we have a sum of positives and negatives, the answer to which is unlikely, even at a round table of experts, to be very accurate. But the fact remains that the cost of winning the oil is increasing, not decreasing. Mr. Beale, from the sources of information he has consulted, gives an estimate of 14 years' supply of oil, the corresponding figures for natural gas and coal being 20 years and over 4,500 years.

Whatever the views on the life of oil and natural gas, it seems evident that the basic fuel resource of the U.S.A. will be coal, and that while the country has been basking in the luxury of large and easily obtained supplies of natural gas and oil for many years, these fuels are being exhausted rapidly—that is, as far as the States is concerned. No doubt there are vast supplies, some of them unexplored, in South America and maybe in Alaska.

Turning to current consumption of the various fuels in dwelling-houses, we have the figures of the Fuel Section of the War Production Board—very interesting figures. This Section estimates that of 34 million houses in U.S.A. 73% are heated by bituminous and anthracite coal and wood, 11% by gas, 10% by fuel oil, and 4% by coke. Coal figures very largely—*i.e.*, coal used in its raw state. The while the cry in responsible Government quarters is clamant that coal should be regarded as a raw material to be treated before use, that it should be the starting-point of large-scale chemical industry and the starting-point for the making of refined and smokeless fuels. The leeway between the present use of coal in its raw state and its employment as a raw material for treatment designed to extract its full value is enormous, and it is not difficult to visualize the extent of the field of coal processing which lies to be developed. Great extension of the manufactured gas industry would appear certain after the war, and we are sure that the American Gas Industry is alive to the possibilities.

The making of comparisons of fuel usage in the home between this country and U.S.A. must, of course, be accompanied by consideration of the different appliances, the different climatic conditions, and the different standards of comfort in the two countries. Even so, the efficiency bases taken in the statistics comprising Mr. Beale's table are surprising. For example, gas usage in Great Britain, credited by Mr. Tomlinson with an overall efficiency of 50%, is credited in U.S.A. with a figure of 60%. Solid fuel in Great Britain, 20%. In America, coke 50%, bituminous coal 45%. The validity of the comparisons may, we suggest, be open to question, though they are interesting. Another point brought out is the quantity of electricity used per family—in Great Britain, 625 units, in U.S.A. 846 units, which is only 35% in excess of British usage; nor do the large American cities—and domestic gas lighting throughout America is non-existent—use vast quantities of electricity *per capita;* in terms of heat the consumption is small, as Mr. Beale's figures show. Not that the analysis as a whole fails to stir the imagination; far from it. It is stimulating that in the States natural gas is pumped 1,000 miles in a 24-in. main at a pressure of 750 lb.—a single pipeline; it is stimulating to note the strides made in air conditioning, refrigeration, and so on. We welcome Mr. Beale's outline as a sidelight on American conditions compared with those in Great Britain.

Personal

The M.B.E. has been awarded to Mr. R. J. H. CLARK, Chief Engineer, Plymouth and Stonehouse Gas Light and Coke Company, and the British Empire Medal to Mr. A. V. NICHOLS, the Works Foreman, for courage and devotion to duty.

* * *

On Sept. 25 Mr. and Mrs. EDWARD T. CHRISTIAN celebrated the 60th anniversary of their marriage. Mr. Christian recently completed 60 years' service as a Director of the Peel (I.o.M.) Gas Company, 53 years of which he has been Chairman.

* * *

In announcing the appointment of Mr. RONALD MASON as Manager of the Teignmouth Gas Department last week, we stated in error that he was Gas and Water Engineer at Clacton-on-Sea. Actually he was Assistant to Mr. F. Allen, who, of course, holds that post.

Diary

Oct. 14.—Institute of Fuel, Annual Meeting and Luncheon, Connaught Rooms, Great Queen Street, W.C. 2.
Oct. 18.—Institute of Fuel (North-Eastern Section), Address by J. G. Bennett, Director B.C.U.R.A., Central Station Hotel, Newcastle-on-Tyne, 5.30 p.m.
Oct. 18.—L.C.C.A. Committees at Gas Industry House: Finance, 11 a.m.; Executive, 11.30 a.m.; Central, 1.30 p.m.
Oct. 21.—Midland Junior Gas Association: Chamber of Commerce Buildings, Birmingham, 4.15 p.m.
Oct. 21.—Midland Association of Gas Engineers and Managers: King Edward House, Birmingham, 2.30 p.m.
Oct. 21.—London and Southern Junior Gas Association: Gas Industry House, 7 p.m.
Oct. 29.—Manchester District Association of Gas Engineers.
Nov. 5.—National Smoke Abatement Society: General Meeting and Conference, Caxton Hall, S.W. 1, 10 a.m.
Nov. 26.—Southern Association of Gas Engineers and Managers (Eastern Section), Paper by Dr. Weston and Dr. Haffner, entitled "New Evidence in regard to the Mechanism of Carbonization in Continuous Vertical Retorts," Gas Industry House.

Letters to the Editor

Organization of the Gas Industry

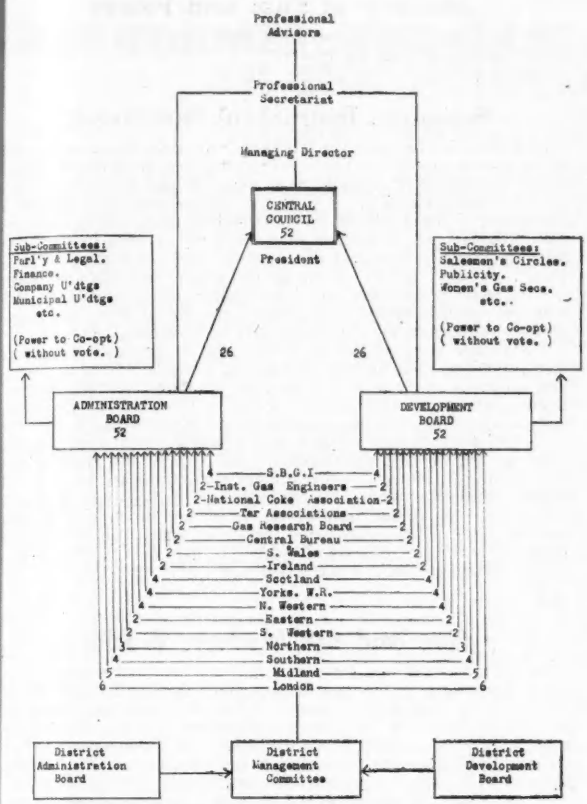
DEAR SIR,—Mr. G. E. Currier ends his letter to you, published in your issue of Sept. 29, with the statement that since there is, generally, great faith in the future of our Industry, and since there is so much difference of opinion at the present time as to the nature and form of the reorganization that must be effected, he fails to see how anyone can reasonably object to the proposals he puts forward.

If one were seeking the easy way out of the problems that beset us, immaterial of whether the reorganization achieved the benefits and advantages to the country and individual we all have in mind, then I am afraid I must agree with him. But many in executive positions in the Industry—and I must admit I am one of them—are not interested in the easy way out; their only concern is the "correct way." Neither are they seriously concerned by the great diversity of opinion which exists throughout the Industry, but are rather perturbed at the absence of a broadminded and tolerant leadership which would, by a correct handling of the position, turn that diversity of opinion into an asset of real value. The very existence of this varied opinion is surely a proof that in the Industry men are thinking on these matters and are alive to their importance. Is that not a desirable state of affairs?

After presenting a bouquet to the holding companies, Mr. Currier states that, in his opinion, the time has come when all false trails should be eliminated, and the right road followed. Agreed, agreed. Then he discusses at length his "all-embracing scheme of public ownership," from which one infers that that is the said road—the all-important highway. Why?

I should have thought much more of the letter had it put forward an argument in support of that conclusion, for surely the first decision the Industry has to make is concerning the type of the reorganization necessary within itself to give the best possible service to the community—not the form it shall take; detail will come later. The mere statement that such and such a type or method is the best is of no value whatever to me and many others in the Industry. We want to know why.

When all the costs of bureaucratic administration have been borne by Bradford under a scheme of nationalization—for that is all that Mr. Currier's form of public ownership means—will the service to the gas



Yorkshire District Proposals for the British Gas Association.

consumers in that city be either cheaper or better than it is, either now or under a scheme of regional integration drawn up and executed by the Gas Industry itself? That is the main question with "in the country" substituted for "in that city."

All the possible achievements credited to his Parliamentary Trustees and Central Gas Board could be much more soundly accomplished and at far less cost by central direction from a properly constituted British Gas Association, with co-operation from Parliament only in respect of supporting legislation; and I have little doubt that facts and figures would prove this conclusively.

In this regard, the members of the Yorkshire District Post-War Planning Committee have given a considerable amount of time and study to what they would consider to be a properly constituted British Gas Association capable of co-ordinating the whole thought of the Industry in a reasonably simple and effective way; and with the thought that some of your readers, Mr. Editor, may be interested in that scheme, I enclose a diagrammatic lay-out of this set-up. It is held by some people that if such a body were straight away elected, it would not be long before majority recommendations could be put before the Industry and Parliament covering the design of post-war reorganization for the Industry. In explanation of the diagram, I think one or two points should be made. First, that one half of the delegates appointed to both the Administration Board and the Development Board are elected also to serve on the Central Council, and, secondly, that no delegate would be elected to serve for longer than three years at a time, a year's break being compulsory before eligibility for re-election is established.

To revert to Mr. Currier's letter, I would state that I am pleased to note that Mr. Currier feels that it is desirable to "retain incentive among individual undertakings," but would suggest that if he thinks that the mere circulation of statistics "would preserve the competitive spirit," it is time he thought again. Personal reward is the urge behind most efforts, and I feel that the Industry and the nation would be losers if executive positions in our Industry became shadowed by the dead hand of bureaucratic advancement.

In conclusion, Mr. Editor, I would suggest that the value of any contribution on the post-war planning of our Industry can be of little use to-day—in fact, it can be a danger—unless it is factual. Assumptions of fundamentals will not do, but at the same time I think individuals, both executive and proprietorial, must be prepared to accept proofs and all they demand as and when they are produced.

Yours faithfully,

Gas-Works, Ravensthorpe. NORMAN HUDSON.
Oct. 4, 1943.

§§

A National Fuel Council

DEAR SIR,—The letter appearing in your issue of Sept. 29 from Mr. G. E. Currier will be welcomed by many well-wishers of the Gas Industry as a constructive contribution—even by those opposed to state ownership.

To the undersigned the most important point made by Mr. Currier is the suggestion of the appointment of a National Fuel Council to co-ordinate (*and direct*) the policies of the fuel industries.

Apart from the undoubted economy effected by the use of gas in certain domestic fields and in industry, the necessity of dealing with peak loads alone emphasizes the indispensability of gas in certain circumstances.

Other important matters such as the conservation of coal, the use of coke in place of raw coal, and the post-war need for oil and other coal by-products in place of imported derivatives of mineral oil, all call for control from some central Directorate, the setting up of which one would have imagined would be the first duty of the new Ministry of Fuel and Power.

As to the control of the Gas Industry itself, it is surely obvious that sooner or later the new body to be set up to direct and control the efficient development of the Industry, whether it is to be known as the "Gas Association" or by any other title, must have over-riding powers similar to those exercised by the Electricity Commissioners—whether company and municipal ownership survive or not.

Without such central authority any scheme such as the setting-up of District or Regional Committees will fail to secure the maximum of efficiency.

In view of the apparent impossibility of securing agreement by consent as to the best method of rationalizing the Industry, I suggest that all the energies of the Industry's leaders and of the Gas Division of the Ministry of Fuel and Power should be directed to the business of efficient gas and by-products production at central works delivering into a national distributing system—eliminating small undertakings, and leaving local control of supply and sale of appliances in the hands of the present owners for the time being as essentials in any reorganization which will enable the Industry to fulfil its proper role in the national economy.

Yours faithfully,

Oct. 2, 1943. CONTRACTOR-MEMBER OF THE INSTITUTION OF GAS ENGINEERS.

Municipalities and Reorganization

DEAR SIR,—This letter is an expression of opinion, not a reply to any correspondence you have received.

On Aug. 25 you referred to an "unpopular" earlier Editorial in your issue of Jan. 28, 1942. That Editorial should be re-read, noting, it is suggested, the concluding remarks of paragraph 3. The sequence of events since early July demonstrates clearly the truth of those remarks. The results of post-war planning to date have been obtained, it is acknowledged, in the first instance, by proposals from the "few"—that is, from a "set piece."

Had evidence been obtained early in the planning procedure, some of the ideas expressed in the "Draft" would never have been printed—these ideas indicate, all too well, that the Post-War Planning Committee, as such, were out of touch with the Industry: in other words, they were not able, or did not wish, to sense the various trends of policy directed towards reconstruction.

With the "re-draft" the writer has little fault to find, but wants to point out—and this is the true purport of this letter—the astonishing interest certain municipalities show in our Industry; these interests have suddenly awakened to what a good thing the Gas Industry really is. It is general knowledge, and it can safely be stated, that there has never been one single case of importance in the Industry in which individual municipally-owned gas-producing units have ever made an honest effort to integrate. Now when unity is our dire need we must contend with serious attempts to frustrate a clearly defined programme.

As the Gas Industry is of a technical and commercial nature, the Government would far better follow these defined plans, which now present the expert professional opinion of the Industry, than jeopardize the future of fuel by segregation of one of the major partners. It should be recognized that the several fuel interests must be treated on an equal basis. Municipalities and public ownership are not compatible, in general, with commercial principles. Parliamentary guidance and co-operation—not controls—are essential when planning on national lines is demanded. This is what everyone must face. If our plans are not accepted during war, it is likely they never will be.

"UPHOLDER."

Oct. 4, 1943.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in the "Journal" should not be taken as an indication that they are necessarily available for export.

Gas and Practical Planning

The "Practical Planning" exhibition organized by the Institution of Civil Engineers and the Institution of Municipal and County Engineers, of which we gave an advance notice in the "JOURNAL" of Sept. 29 (page 401), was opened by Mr. W. S. Morrison, Minister of Town and Country Planning, on Oct. 5, and will remain open to the public until the end of the month.

Mr. Morrison said the two Institutions had modified their austere traditions of reticence, and showed by the exhibition that they had learnt the value of the modern arts of publicity, which they had employed not only with propriety and skill, but for practical purposes and in a planned shape. The exhibition was designed to show how modern civilization depended on the work of the engineer. It was important that engineers should be in touch with the growing company of research workers, and that they should collaborate with the town planners, who relied upon the groundwork of knowledge which the research workers provided.

Gas has its deserved place in the general scheme of the exhibition, which outlines the whole course of planning from a study of conditions as they are to-day, through the many fields of research on physical and economic factors, right down to the model post-war kitchen and the sound-insulated room of the future. The Gas Industry's contribution to smoke abatement, the economics of coal carbonization, and some of the uses to which the valuable by-products of the Industry are put, are illustrated in a series of three panels in the centre of the exhibition. District heating, with some examples from the Treforest Trading Estate and details of a proposed scheme for Coventry, and a section on heat conservation by lagging pipes and boilers, and by the use of efficient appliances, adjoin the gas exhibit, and there is a model of the Birmingham kitchen, designed by a group of Birmingham women, with models of gas and other appliances, suitable for use in it. Although only models are available in the exhibition kitchen, there are a few actual appliances on show nearby, including a cooker, water heater, and gas-operated refrigerator.

Institute of Vitreous Enamellers

The Annual General Meeting of the Institute of Vitreous Enamellers was held in London on Oct. 9, when several technical Papers were presented. Mr. J. T. Gray (Stewart & Gray, Ltd., London) discussed post-war prospects and developments in the vitreous enamelling industry. He argued that the vital problem of the post-war development and resuscitation of the industry calls for a careful study of what the potential post-war demand will be. Trends in post-war design and planning will determine the future of the industry. Among the trends reviewed by the Author were the wider adoption of "unit construction" in housing equipment, the vast requirements of the many new homes which must be built and equipped, the future of refrigerators, and competition between pressed-steel and cast-iron baths, the use of vitreous enamels for fluorescent-tube reflectors, the outlook of the sign trade, the more extended use of vitreous enamel for coach fittings and in architecture, with examples. Among wartime developments on the technical side are the elimination of tin oxide as an opacifier and the progress made in acid-proof enamels, the latter being frequently used unnecessarily. Alternative finishes are likely to offer serious competition to vitreous enamels.

Mr. J. Fallon (Incandescent Heat Company, Ltd., Smethwick) presented the case for the continuous furnace, and compared its thermal characteristics and efficiency with those of the static furnace. In vitreous enamelling shops the continuous furnace can, he said, be successfully applied if the prerequisites are met. The best form of fusing unit was discussed. Other important applications of the continuous heating principle in the vitreous enamelling industry, which were considered, are gas pickling, drying with infra-red radiation, the modern convection oven, the annealing of castings, degreasing in controlled-atmosphere furnaces, and frit melting.

Dr. G. T. O. Martin (Hon. Gen. Secretary and Research Officer) described a new and rapid method for measuring the amount of grip-coat picked up by sheet steel. The technique, which, he suggested, offers a great saving of time over the usual weighing method, was developed in the laboratory and has since been successfully applied to works practice. It depends on measuring the light transmitted by the enamel picked up by a standard glass testplate, the amount of light transmitted being a measure of the thickness of the enamel adhering to the plate. In the present form of the test, the degree of light transmission is measured by visual comparison with a series of permanent standards; other methods of estimation are also feasible.

As from Monday Last, the address of the British Chemical Plant Manufacturers' Association is 26, Portland Place, London, W. 1. Telephone No.: Langham 3121.

Consequent on the Recent Death of the Chairman, Mr. J. Reginald Lane, it has been decided to close the offices at Martins Bank Chambers, 36, Bennetts Hill, Birmingham, 2, of Lane Brothers (Tar Distillers), Ltd., for the duration of the war. Correspondence previously addressed to that office should now be addressed to Sandhills, Walsall Wood, near Walsall, Staffs. Telephone: Brownhills 2117.

Ministry of Fuel and Power

Dr. W. A. Macfarlane has been appointed Director of Fuel Efficiency in the Ministry of Fuel and Power.

Scientific Instrument Handbook

In preparation for post-war activities, both in the home market and in the re-establishment of trade relations abroad, the Scientific Instrument Manufacturers' Association of Great Britain has undergone an extensive reorganization. One of the first results is the issue of a Handbook giving details of the Association's aims, constitution, and plans, showing the formation of committees to form liaisons with other industrial bodies and with research and Government Departments. A short history of the growth of the scientific instrument making industry indicates the pioneer nature of instrument development and craftsmanship in this country, and should have considerable prestige value when the Handbook may be distributed abroad.

Details are given of the extensive range of products of member firms, classified so as to show in the most convenient form the names and addresses of the manufacturers, and a section of manufacturers' announcements gives the classes of goods in which they are interested, and details of their internal organizations. There is also a useful list of associated research bodies and kindred trade organizations. Marked "Private and Confidential," the issue of the Handbook is strictly limited, although when present restrictions are lifted it will become invaluable to almost every industrial concern and educational institution. A limited number of copies are procurable through member firms of the Association, details of which can be obtained from the secretaries, Messrs. Binder, Hamlyn & Co., River Plate House, 12 and 13, South Place, London, E.C. 2.

Gas and the Modern World

To tell the world, and more especially the men and women in the Services, the story of the contribution which the Gas Industry makes to the welfare of mankind by way of all the products of the gas-making process, the Women's Gas Council has presented an exhibition under the title of "Gas and the Modern World—The Dramatization of an Industry." The exhibition comprises twelve separate panels tracing the production from coal of gas, coke, tar, benzole, explosives, plastics, fertilizers, insecticides, dyes, drugs, and waterproofing materials, using photographs with topical and Service interest, with colourful art work depicting the more domestic angles. The show is designed on simple lines with very little reading-matter, to allow the pictures and illustrations to tell the story. Because of the wide field covered by the exhibition it is hoped that the display will suggest a number of subjects that can be pursued by discussion groups in different units. This point is considered especially important, as open discussions do much to stimulate interest in a subject and to foster a desire to study it further.

The exhibition which was on view for a week at Gas Industry House has been handed over to the Army Bureau of Current Affairs for distribution to units in all Commands. It had a very good opening on Oct. 1, when Miss Wolseley-Lewis, Chairman of the Women's Gas Council, welcomed a distinguished assembly at a private view at Gas Industry House. The guests included Members of Parliament, officers of all branches of the Services, the United States Army and W.A.C., the Canadian W.A.C., and representatives of the War Office, Ministry of Fuel and Power, Ministry of Information, the Housing Centre, the Food Advisory Bureau, the Association of Women Housing Managers, the National Council of Women, the British Coal Utilization Research Association, the W.V.S., and other organizations. In a brief speech of welcome, Miss Wolseley-Lewis apologized for the unavoidable absence of the Dowager Lady Nunburnholme, President of the W.G.C.

United Kingdom Gas Corporation, Ltd., has declared an interim dividend of 2 % (actual) less income tax for the year ending Dec. 31, 1943, payable on Nov. 16.

Clitheroe's Street Lighting is to be increased by 25%, the Lighting Committee Chairman and Lighting Engineer to arrange for additional lamps at their discretion.

The Dismantling of the airship mooring tower at Cardington, by Cox & Danks, Ltd., has been completed. This was accomplished well inside scheduled time, and 300 tons of steel are now in the process of arms production.

A Meeting of the Midland Association of Gas Engineers and Managers will be held at King Edward House, Birmingham, on Oct. 21, when a Paper will be given by Mr. Arthur Forshaw, M.Sc., dealing with the present state of development of domestic gas appliances for cooking, water, and space heating.

The Annual Distribution of the employees of Messrs. Alder & Mackay, Ltd.'s, contributions to Edinburgh charities was made on Sept. 30. This year the amount contributed totals £208 17s. 9d., which has been divided as follows: Edinburgh Royal Infirmary, £127 7s. 5d., Sick Children's Hospital, £42 5s. 2d., Queen's Institute of District Nursing, £39 5s. 2d.

GAS FLAMES: THE CASE FOR AERATION ENTIRELY AT THE POINT OF COMBUSTION*

By DEAN CHANDLER, South Metropolitan Gas Company

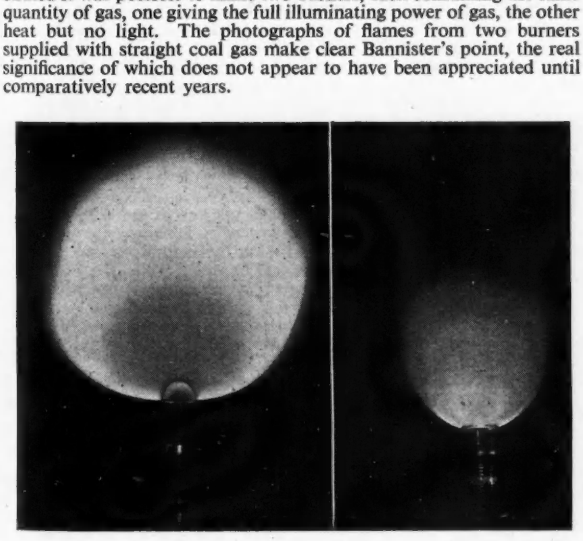
On several occasions during the past seven years I have drawn attention to the advantages of non-aerated gas burners for cooking stoves and other gas-heated appliances, and from time to time I have made known the results of our work. I have little to add now, but I hope this meeting may be able to contribute usefully to a subject which some think is being unduly stressed; on the other hand, there are those who think the matter is of sufficient importance to justify all the attention given to it, believing that in this type of gas burner we have an instrument of precision which, if used more generally in heating appliances, would do much to simplify gas utilization practice. This view is shared by not a few in the Industry who are experienced in district matters, and who now look to technicians to provide the means whereby simplification in practice can be achieved in post-war days.

I think there is already not only a trend, but a definite movement in the direction of practical development, and our friends the makers of gas appliances—always cautious, and rightly so when their long established practices are challenged—are alive to the possibilities of this type of burner. As most of you know, gas fires are now being fitted with such burners, and at least one maker has been working on a new construction of cooking stove fitted with neat gas flame burners.

I am pleased, therefore, to have this opportunity of putting before you my views on the matter, and of stating quite simply the grounds on which my advocacy has been based. If, in stating the case, I deal with matters of common knowledge, it is because the logical development of the story requires it. I mention this because it might be thought presumption on my part to refer to such commonplace matters.

At the outset let me say my story will be told in simple language, and that is as it should be, for it is mainly concerned with the simplest of devices.

First, then, may I remind you that practically all gas burners in domestic appliances and in many industrial furnaces operate either on the principle applied by Bunsen in 1855, by which a proportion of the air required to burn the gas is entrained by a jet of gas in a tube provided with air-inlets, the gas and air being mixed together prior to combustion in a flame entirely without luminosity, or on the principle of aeration of the flame entirely at the point of combustion by means of a burner, which, be it noted, was designed originally to develop as much light as possible from the gas supplied to it. Here I would ask you to notice that it was to this type of burner that Bannister, of the Westminster Gas Company, referred many years ago when he pointed out that numerous experiments by scientific men in this country, and by Reynault and Dumas in France, had demonstrated it was possible to make two burners, each consuming the same quantity of gas, one giving the full illuminating power of gas, the other heat but no light. The photographs of flames from two burners supplied with straight coal gas make clear Bannister's point, the real significance of which does not appear to have been appreciated until comparatively recent years.



If our present-day problem is to be seen in its proper perspective, and in the light of the changes which have taken place in the practice of gas manufacture and the utilization of gas since Bunsen invented his famous burner (when gas was used almost exclusively for lighting by self-luminous flames), it is necessary we recall to mind the aim of the gas engineer of those days, which was to produce "fat" gas, and the aim of the gas burner maker to produce burners that would develop as much light as possible from the hydrocarbons in the gas.

For the greater part of the nineteenth century those responsible for the distribution of gas endeavoured to keep the pressures in the mains down as low as was practicable, not merely to reduce leakage, but also to ensure a low velocity of the gas from consumers' burners, and thus to aid the development of light from the flame. Those were the days when it was one of the duties of the carbonizing foreman to keep an eye on the jet photometer to see that "candle power" was good, and not infrequently a few charges of "cannel" were used to "top it up."

Such were the conditions when Bunsen evolved his famous burner to heat beakers, flasks, and crucibles without the production of soot. The calorific value of the gas in those days was in the region of 600 B.Th.U. Now all that has been changed and we can date the beginning of the change from 1885, when Carl Auer made the discovery which gave to the world a system of gas lighting which did not depend on the presence of hydrocarbons in the gas. It was this invention which enabled gas undertakings a few years later to reduce considerably the intrinsic illuminating power of gas, and in due course to remove the benzole from the gas when that became expedient.

Had the gas supplied in Bunsen's day been tested in the Carpenter Argand test burner it would probably have given a value of eighteen candles or more; to-day town gas, when tested, has little more than a quarter of that value. I venture to think that if Bunsen were with us to-day he would make use of the non-aerated gas burners for heating. A simple but instructive experiment will demonstrate that this belief is not unreasonable. This experiment consists in heating water in two beakers, using in one case a bunsen burner of the ordinary laboratory pattern and, in the other, a neat gas flame burner. It can be shown that in each case the combustion of the gas is satisfactory even when there is actual contact of the flame with the cold surfaces of the vessels. The efficiency of heat transmission is approximately equal, but unless the bunsen flame is adjusted the efficiency can easily be lower with it than with the neat gas flame.

I have spoken of matters which I believe are fundamental to the proper understanding of our problem of the use of neat gas flames. The changes which have taken place in the conditions of gas supply have been such that it is now reasonable seriously to consider the more general use of the simple form of gas burner for heating.

Here I digress for a moment to note one item of interest. Bunsen made no attempt to patent his invention. Henry Roscoe, in his memoir, tells us that "Bunsen had no idea of making money out of his discoveries." There were others, however, who quickly sought to make capital out of his invention. In 1856, one year after the birth of the famous burner, two gas engineers, Henry Fly Smith and George Pettit, in letters patent 193–1856 described more than a hundred different appliances based on Bunsen's principle. These two gentlemen, if they produced burners and apparatus in accordance with the illustrations shown in their specification, must have given gas engineers of that day a very unhappy time, for their pieces of apparatus must have been crude, and lacking all those features of design essential to the proper working of bunsen burners.

Examples of Application

It now remains to give some examples of the application of neat gas burners to heating apparatus, but first may I disabuse your minds of the idea, if it exists, that I claim any originality for the idea that so-called "luminous gas burners" should be used to heat cooker ovens. All I have done is to direct attention to the possibility; to urge study and investigation, and to express my conviction that the Gas Industry stands to gain not only by their use in the oven but also for hotplate work. My attitude to this problem had the support of the late Dr. Charles Carpenter, whose judgment on such matters, from long and intimate knowledge of the Industry and of district requirements, demanded great respect. In a latter to me, written in 1935, he said that "For many years I have been puzzled by the adherence of the Industry to non-luminous burners for cooking stoves. The late William Sugg made stoves fitted with luminous burners which he stated were free from the defects of more complicated burners in general use." Dr. Carpenter considered that Sugg was right when he postulated that "a luminous gas flame from a steatite burner is the proper source of heat for cooking stoves."

It may be within the memory of some of the older folk in our Industry that Sugg was awarded the Diploma of Merit by the National School of Cooking for his stove, and Marie Jenny Sugg, a French lady highly accomplished in the art of cooking, in her manual on the subject said that Mrs. Clark, of the National School of Cooking, "after careful and extended trials at South Kensington, finally adopted luminous flames for the ovens at the School in Buckingham Palace Road, having proved to her satisfaction that they were better than Bunsen flames."

* Paper to the Southern Association of Gas Engineers and Managers (Eastern District), Oct. 6.

You may ask why did Sugg ultimately abandon the simpler form of burner? My answer is that the demand created by publicity for the atmospheric burner was too strong for Sugg to resist alone, and he was forced into a policy opposed to his personal conviction. Sugg, I believe, was never converted to the idea that cooking was easier or better when the oven was heated by atmospheric flames, neither did he believe it was right in principle to use this type of burner. I think his judgment was sound. It should be noted that Sugg always had a pressure governor with his luminous flame cookers.

I do not propose to deal with the subject of the structure of flames, although it is fundamental to a clear understanding of the practical problems. The work of Bone and Townend described in their book, *Flame and Combustion in Gases*, should be studied by those who are interested in that aspect of the problem. My immediate purpose is to put before you some considerations regarding the practical application of "neat-gas" burners.

Many experiments have taught us how to apply this type of burner successfully to gas oven heating. Many gas ovens in South London have been fitted with this type of burner, and the experience of Dr. J. S. G. Thomas, reported to the Severn Valley Gas Corporation (see "GAS JOURNAL" of April 21, 1943), is the testimony of one trained and critical observer of the merits of "neat-gas" burners.

The conclusion to be drawn from our work on gas ovens is that improvement in the flexibility of oven flames is limited more by the burners than by any other factor. It appears to me that you can design more satisfactory ovens if you use non-aerated burners. We usually say airily that non-aerated burners are more flexible and more stable than bunsen burners without realizing the full import of the words. With the type of oven shown it is possible to keep plates hot at 200°F. safely using only 1,000 B.Th.U./hr., although its full-on rate is 8,500 B.Th.U./hr. That is flexibility and flame stability in practical terms.

There is a very general impression abroad that the conventional type of thermostat is essential to good cooking, and it is alleged that without it good cooking is not easily achieved.

I do not subscribe to this view, and I believe a graduated tap, when used in conjunction with a fixed gas orifice and a governed pressure, is all that is needful, provided common sense and intelligence is used in the kitchen.

In an endeavour to simplify cooker fittings, experiments were made with a gas tap of screw-down type to replace the conventional thermostat. Investigation showed that the temperature of the waste products leaving the oven, to which the heat detector of the thermostat is usually exposed, is not necessarily a factor of paramount importance in many cooking operations. The governing factors for successful cooking, apart from time, are more properly the amount and distribution of the heat in the oven. This conclusion has led to the production of a gas tap to give the necessary range of gas rates. This was not a difficult matter, as the range of gas rates can be controlled by the sizes of the valve and the pitch of the thread on a screw-down spindle. With the proper combination, a pressure governor, a fixed gas jet, and a tap of the type I have described, good cooking can be achieved with just as precise control and as little attention as if a thermostat had been fitted.

Gas Cooker Components

With the gas cooker in mind, there are one or two points which should be noted. I have come to the conclusion that fundamentally we should look upon a gas cooker as consisting of three parts, not two, as we have customarily thought of it. This may not be a pleasing idea to those who are wedded to the traditional conception, but I am satisfied that to treat a cooker as consisting of (1) an oven, (2) a hotplate, and (3) a griller as an independent unit is right in principle and sound in practice.

It is no secret that in the evidence given to the I.G.E. Committee of Enquiry on Domestic Gas Appliances, the griller came in for most criticism on the ground of its size, efficiency, and the fact that it often degenerates into a dirty and offensive component of the stove.

My own opinion is that the griller should not be an integral part of the hotplate, but should be an independent unit, easily and conveniently connected to the cooker when it is required. The whole area of the hotplate can then be used to accommodate, if desired, four boiling rings, and, what is most important, the height of the hotplate from the floor can be reduced by some three or four inches.

An enquiry we instituted recently to ascertain the views of a number of consumers as to the most desirable height of the cooker hotplate from the floor revealed that of 434 women asked to give their opinion on three cookers withhotplates at different heights from the floor:

72	chose	2 ft. 8 in.	high—16.6%.
307	,,	2 ft. 10 in.	,, —70.7%.
55	,,	3 ft. 0 in.	,, —12.7%.

Burners for the Cooker Hotplate

The adaptation of this type of burner for hotplates at first presented some difficulty, but after many different devices and arrangements have been tried one has been evolved which has proved practical in daily use. A number of small jets are mounted on a burner head, which is made of metal or other suitable material in the form of a frustrum of a cone, into the sloping surface of which a definite number of the small jet components are screwed. On top of the burner head is mounted a circular metal plate with its upper surface $\frac{3}{8}$ in. above the level of the orifices. For some purposes the burner head is made so that it can be easily removed from the gas supply pipes by a cone fitting joint. In some cases the cone joint is not desirable and the head is screwed easily on to the supply pipe.

The burner has correctly proportioned rectangular orifices in steatite heads. Three standard sizes have been found to be necessary for gases ranging in calorific value from 400 to 530 B.Th.U. per cu.ft. of gas.

With burners constructed on these lines, thermal efficiencies with a number of different qualities of gas have varied from 45 to 58%. These variations have been levelled by suitable modifications, so that a figure of about 50% on the test bench has been obtained.

The figures in Table I are the results of tests on different qualities of gases supplied by several gas undertakings in different parts of the country. The tests show a reduction in thermal efficiency as the calorific value falls and the density increases. All the tests were made with jets having the same size of orifice, which demonstrates the flexibility of the burner. All the tests were made with a gas pressure of 25/10ths water column in supply pipe, with the exception of "C," where the pressure was lower, this accounting for the increase in time to reach boiling temperature.

The gases "C" and "D" require jet orifices of a larger size to accommodate the lower calorific values, and higher densities. The efficiency can than be restored to 50% and the time to about 9 minutes.

TABLE I.

Gas.	Calorific value.	Density.	Efficiency on gross C.V.	Time to boil 3 pints of water.
A	530	0.390	53%	9 mins.
B	500	0.450	50%	10 ,,
C	475	0.500	47%	11½ ,, *
D	450	0.500	47%	11½ ,, *

* When a larger size orifice was used for these gases the efficiency was 50%, and the time to boil 9 minutes.

Note.—One result was obtained in a stove manufacturer's laboratory in the Midlands on a gas of 432 B.Th.U. (density not given); the efficiency obtained was 49.5% and time to boil 11½ mins.

TABLE II.—"NEAT GAS" BOILING BURNER AND THE EFFECT OF VARIOUS GAS MIXTURES ON ITS BEHAVIOUR.
(All the tests were made with jets having the same size orifice.)

Mixture	South Met. Gas	A		A		A		B		B		B	
Gas made by mixing	Straight coal gas	30 cu.ft. of 530 B.Th.U. gas with 9.7 cu.ft. waste gases (80% N_2 + 20% CO_2)		30 cu.ft. of 530 B.Th.U. gas with 5.4 cu.ft. waste gases (80% N_2 + 20% CO_2)		30 cu.ft. of 530 B.Th.U. gas with 1.8 cu.ft. waste gases (80% N_2 + 20% CO_2)		14 cu.ft. of 530 B.Th.U. gas with 16 cu.ft. blue water gas (290 B.Th.U.)		20 cu.ft. of 530 B.Th.U. gas with 10 cu.ft. blue water gas (290 B.Th.U.)		26 cu.ft. of 530 B.Th.U. gas with 4 cu.ft. blue water gas (290 B.Th.U.)	
Calorific value (B.Th.U.)	530	400		450		500		400		450		500	
Specific gravity	0.410	0.563		0.498		0.441		0.490		0.464		0.430	
Composition of gas: CO_2	% 1.5	% 6.0		% 4.3		% 2.5		% 3.2		% 2.55		% 1.9	
O_2	0.2	0.2		0.2		0.2		0.1		0.15		0.2	
C_nH_m	3.6	2.7		3.05		3.4		1.67		2.4		3.1	
CO	7.4	5.6		6.3		7.0		25.9		18.9		12.0	
CH_4	27.5	20.8		23.3		25.9		12.83		18.35		23.8	
H_2	52.0	39.3		44.1		49.0		50.5		51.0		51.5	
N_2	7.8	25.4		18.75		12.0		5.8		6.65		7.5	
Gas pressure	20/10 in.	20/10 in.	30/10 in.	20/10 in.	30/10 in.	20/10 in.	30/10 in.	20/10 in.	30/10 in.	20/10 in.	30/10 in.	20/10 in.	30/10 in.
Hourly rate (cu.ft.)	14.0	12.55	15.80	13.2	16.3	13.95	17.00	12.7	15.95	13.4	16.1	13.7	17.0
Heat input (B.Th.U./hr.)	7,430	5,020	6,320	5,940	7,335	6,575	8,500	5,080	6,380	6,030	7,245	6,850	8,500
Gas used (cu.ft.)	2.37	3.25	3.55	2.82	2.99	2.5	2.63	3.20	3.33	2.79	2.89	2.54	2.61
Time taken (min., sec.)	10 0	15 35	13 30	12 50	11 0	10 45	9 20	15 15	12 40	12 55	10 40	11 5	9.13
Efficiency (%)	52.7	50.8	47.6	52.2	49.5	53.0	50.3	51.8	49.6	52.9	51.0	52.2	50.8

Note.—A mixture made by diluting S.M. Gas 530 B.Th.U./cu.ft. with waste gases (80% N_2 + 20% CO_2).
B ,, ,, ,, ,, 530 ,, ,, blue water gas (290 B.Th.U./cu.ft.):
The quantity of water raised through 150° F. used in each determination of efficiency was 2,000 c.c.

The bench test figures on experimental gases from 400 to 530 B.Th.U. per cubic foot are given in Table II.

An interesting and instructive experience with one of these burners is noteworthy. At a coast town there was a temporary trouble at the gas-works which resulted in sudden and fluctuating changes in the quality of gas. The trouble lasted for several days, thus giving me, in the house in which I was staying, an opportunity of testing one of the burners I have described to you, and noting its performance against the bunsen burners which were giving trouble on a cooker of well known make extensively used in all parts of the country. With the gas as normally supplied the burners had functioned reasonably well, but they were most erratic and difficult to manipulate with the unusual gas being sent out. Efficiency tests obtained with the bunsen burner on the cooker, using a new enamel saucepan purchased locally for the purpose, gave a figure of 39%, and the time to boil two pints of water was 10 minutes. The "neat gas" burner with the same quality of gas and the same day gave an efficiency of 48%, and the time taken to boil two pints of water was 6 minutes 20 seconds. The declared calorific value of the gas was given as 475 B.Th.U., but probably it was nearer 400 B.Th.U. for the few days while the trouble lasted.

I have not time to describe all the experimental work we have carried out in the development of other applications of these simple gas flame burners, but I hope the information I have been able to give has provided some food for thought.

The advantages which support the case for the type of gas burner wherein aeration of the flame is carried out entirely at the point of combustion are:

1. Absence of noise.
2. Freedom from trouble arising from dirt and dust.
3. Fixed dimension orifices in hard incorrodible material.
4. Standardization of a limited number of gas jets attainable.
5. Absence of adjusting devices.
6. Back-firing troubles abolished.
7. Much less sensitive to changes in quality of gas.
8. Maintenance made easier and less costly.
9. Simplified testing of appliances.

DISCUSSION

Mr. **L. W. Andrew** (London and Southern District Junior Gas Association) congratulated the Author on his pioneer work on the application of "luminous" flames to water heaters, fires, and now to cookers. It was, of course, important that in making comparisons between the performance of the "neat" flame with the bunsen flame the basis should be between the most modern types of appliance; and he would say that the cooker burner with fixed injector, fixed air ports, and governor was very satisfactory, though no doubt they could look to an aerated burner of what he might term "neater" design. Regarding blockage of the burner by dirt, he suggested this might have worse results with the "neat" gas burner than with the aerated burner; the gas rate would be reduced and there would be alteration of flame shape. Also, if the burner was screwed on, would people readily remove it for cleaning? He would like to see many cookers of the type shown by the Author in use on the district with many different types of consumer; the experience on the district would, he thought, be invaluable. There was another point, and that was the idea of having the griller as a separate unit. Did that imply that they were ashamed of the griller as part of the cooker? After the war he hoped that the griller would be considered as the finest part of the cooker and would be integral with it.

Mr. **Chandler** remarked that "neat" flame cookers had been in use for years in the homes of consumers where they got no attention at all. He recalled one "complaint"—and that after four years' service—that the oven was not "heating properly." The conditions under which the cooker had been used during those four years were the reverse of good, but on investigation it was found that one out of the five jets of the oven burner was not functioning. A simple brushing of the burner restored it to its initial efficiency.

Mr. **C. A. Deas** (Tottenham) asked whether the Author had attempted to adopt the "neat" flame burner for lighting purposes.

Mr. **Chandler** replied that the use of the "neat" flame burner for lighting was, so far, impracticable except for very small units.

Mr. **R. N. Le Fevre** (Gas Light and Coke Company) thought that perhaps the Author might explain more explicitly the difference between aerated and "luminous" flames, and suggested that the question of nomenclature, the use of the term "neat," might to good purpose be discussed. After all, both types of flame had to be "aerated," and whether we consumed gas in a bunsen burner or in a "luminous" burner, the fact remained that for complete combustion a given quantity of gas required the same quantity of air. Again, "neat" had in common usage more than one meaning. It might be defined as "tidy and clean," as distinct from "untidy." Again, it might be interpreted as "snappy"—"neat and snappy." If, therefore, they were to employ the designation "neat" for the burner described by the Author, would there be a tendency for the general public to think the bunsen flame was not "neat" but was untidy, unclean, and "diluted"?

Mr. **Chandler,** on the analogy of "If you know of a better hole, go to it," said that, as Mr. Le Fevre had argued, "neat" did in fact apply to both bunsen and "luminous" flames; at the same time there was a difference. Perhaps somebody would advance a better expression than the one he had put forward—*viz.*, "neat"—to differentiate between the bunsen and the so-called "luminous" flame, which, as he had emphasized, was under modern conditions of gas supply and burned in a "neat" gas burner not by any manner of means "luminous."

Mr. **J. H. Dyde** (Uxbridge) asked whether the deflector plate over the "neat" gas hotplate burner was steel, and whether it had in use shown signs of wear and tear. Also was there not a tendency towards luminosity of the flame at low rates of consumption? And at such low rates was there a tendency to sooting? Was the efficiency with the deflector plate at low rates of gas consumption as good as that of the present bunsen burner? Finally, had there been any difficulty as a result of gummy deposits?

Mr. **Chandler** replied that the deflector plates were made of heat-resisting steel, and the overall efficiency of the burner was as good as that of the present bunsen burner as normally used at the lower rates of flow. There had been no difficulty with gumming and no tendency to sooting.

Mr. **S. L. Wright** (Deal) asked whether there was any minimum pressure at which the "neat" gas burner should be supplied with gas. He also emphasized how needful it was that they should eliminate noise and "hissing" from gas-burning appliances—and the Author's burner was silent.

Mr. **A. H. Greaves**, called upon by the Chairman (Mr. J. M. Webber, Croydon), explained that he had written to the "GAS JOURNAL" about a bunsen burner which he and his father had developed quite by chance. This burner, which operated on the principle of two-stage injection, gave more than theoretical air-gas ratios and did not light-back. When the gas was turned low the burner gave a "neat" flame, and when turned full on air-gas ratios up to 6 to 1 were obtained at a pressure of 3½ in. W.G. He hoped post-war to put the burner on the market. He was not a gas engineer, but he seemed to have hit on a lucky solution to the problem.

Mr. **Edwards** (Southampton) remarked that even with the bunsen burner having a fixed orifice and jet there was a tendency for the flame to be blown out by draughts when the gas was at low rates of consumption.

Mr. **P. Richbell** (Croydon) enquired at what pressure the governor was set on the Author's cooker, and whether Mr. Chandler advocated an individual governor on each appliance.

Mr. **Chandler** replied that the governor was set at 20-tenths pressure. He thought that all appliances should be individually governed unless there was a service governor and the internal carcassing was adequate.

Mr. **S. E. Whitehead** (Southampton) remarked on the Author's statement that when the burner became hot the gas rate showed a reduction. As a consequence, was there a falling-off in the speed of boiling?

Mr. **Chandler** said the point was that the burner was capable of satisfying the requirement of bringing to the boil in 9 minutes 3 pints of water.

Mr. **A. Tennant** (East Surrey) asked what provision was made in the Author's cooker for plate warming.

Mr. **Chandler** suggested that it was preferable to have an independent unit for the purpose, but it was simple enough to have boxes at the side of the oven, though this would add to expense.

Mr. **Dyde,** commenting on speed of boiling, said he favoured a high-duty burner, of a gas rate not less than 25 cu.ft. an hour, on the cooker hotplate.

Mr. **Chandler,** in reply, suggested that the cooker hotplate was not the place to fit high-power burners. His own view was that they should have separate high-rate burners for speedy boiling.

Colonel **F. J. Bywater** (President of the Southern Association of Gas Engineers and Managers), proposing a vote of thanks to the Author, paid tribute to the work which Mr. Chandler had carried out with such assiduity over a long period; and he expressed the view that the time had arrived when the burner advocated by Mr. Chandler should be tried out over the country.

Mr. **S. E. Whitehead** seconded the vote, and Mr. **Chandler** replied.

B.C.U.R.A. Welcomes Hard Coke Committee

The Research Committee of the British Hard Coke Association is concerned with research on the utilization of coke-oven coke and is at present engaged in correlating and expanding these activities. It was therefore appropriate that the members of this Committee should be invited to inspect the laboratories of the British Coal Utilization Research Association. The visit took place recently when the party was welcomed by Mr. J. G. Bennett, the Director, with a brief talk explaining the activities of his Association and the way in which these are organized. Many of the technical questions under investigation had a bearing, he said, on coke as well as coal, and this was illustrated during the subsequent tour of the Kingston and Fulham premises.

After a lunch at which the visitors were entertained, their thanks were briefly expressed by Mr. R. Alsop, C.B.E., Chairman of the Research Committee. He said that the equipment and methods they had seen were most impressive, as also was the organization of the work. The British Hard Coke Association much appreciated the opportunity to inspect the B.C.U.R.A. laboratories.

GAS FUEL IN POST-WAR PLANNING

Notes from the U.S.A. by S. J. BEALE,

General Manager, West's Gas Improvement Company of America, Inc.

THE Author makes the following comment, from the angle of conditions in America, on the Paper by Mr. T. A. Tomlinson on "Gas Fuel in Post-War Planning"—see "JOURNAL" of March 3, p. 277.

As the U.S.A. is very different from Britain in regard to climate, national resources, and area, it is difficult to find parallel data to those given by Mr. Tomlinson. The following data were obtained from the American Gas Association, the American Petroleum Institute, the U.S. Bureau of Census, the U.S. Bureau of Mines, and the War Production Board—Office of Civilian Supply—Fuel Section. Those not procurable from one source were obtained from another. Sometimes similar data from two sources do not agree in detail, but the variations are not significant.

The use of considerable quantities of anthracite, oil, and natural gas as fuels in the U.S.A., combined with the general use of central heating, and more air-conditioning each year until war came, makes a comparison of material civilization most difficult. The U.S.A. is rich in mineral resources. It has been estimated there are:

20 years' supply of Natural Gas.
14 " " " Oil.
Over 4,500 " " " Coal.

The table on p. 457 shows comparative figures for the two countries. British figures are mostly based on 1938 returns and those of U.S.A. on 1940, being the years before each country went to war. It is useful to remember that Britain has a population of about 44 millions, while the U.S.A has 132 millions, just three times as much. The U.S.A. produced twice as much coal as Britain, but only exported 23 million long tons compared with Britain's 52 millions. However, the U.S.A. also produced 81,110 million therms in the form of oil, 28,720 million therms of natural gas, and 8,930 million therms of water power—a total of 118,760 million therms, not taking into account wood and sawdust which is burned as domestic and industrial fuel in some forest areas.

Taking the U.S. coal output of 132,360 million therms as 100%, other fuels, excepting wood, represent an additional 90% fuel supply. British coal output was 66,617 million therms, which is assumed to be total fuel produced. U.S. total fuel produced was 251,120 million therms or 377% of the British for 300% of British population, leaving a comparative surplus of 77% over British fuel production.

Total domestic coal consumption *per capita* in Britain was 3.8 long tons and 3.30 long tons in the U.S., or 87% of British consumption. Total domestic fuel used in Britain was 1,240 therms and in the U.S. 1,656 therms, or 34% more *per capita* in the U.S.A.

It is interesting to note that six times as many therms of gas are used in the American as in the British home, or double the amount *per capita*. This is largely due to the cheapness of natural gas.

In British homes the total useful fuel per family was 240 therms compared with 693 therms in the U.S., the former being 35% of U.S. usage. This low figure is accounted for by the low efficiency of British open fires as compared with American stoves and furnaces, which have much higher efficiencies. There is a possible error in the estimate of total coal used in U.S. homes, as detailed figures are not available and estimates may be on the high side. However, they will not be sufficiently high to alter the effect of the figures.

Due to oil heating of homes and the greater use of cars it is interesting to note that liquid fuel consumption in the U.S. is 14½ times that of Britain, or five times as much *per capita*. Motor spirit used in the U.S.A. is thirteen times that in Britain, or over four times as much *per capita*.

There has sprung into existence since about 1930 a liquid petroleum gas industry which is growing rapidly, as indicated by sales increase of 47.7% in 1941 compared with 1940, and quadrupling of sales in five years to 1941. These gases are butane, propane, butane-propane, and pentane. Sales of these in 1940 totalled 313,456,000 U.S. gallons, of which 134,036,000 gallons were for use in homes. There is no record of the number of customers, as they are in rural districts and are supplied by cylinders, which usually are connected to the house piping from an enclosed lean-to adjacent to the house. There are a few cases where communities are piped and the liquid gases vaporized from a central location into the mains.

The Fuel Section of the Office of Civilian Supply, War Production Board, estimates fuels for residential use are used about as follows:

Most bituminous coal consumed in East and Central areas.
" coke " " " "
" wood " South " "
" fuel oil " East and West areas.
" gas fuel " pretty well all over.
No anthracite coal consumed in the West because anthracite is mined in the East (Pennsylvania).

In the south and parts of the Pacific Coast area there is more space heating than central heating, as only a few days per year require house-heating. Yet in the west, mid-west, north, and east there is extreme cold in winter, from over 40° below zero Fahrenheit in some areas to only a few degrees below zero in the east, and extreme heat in summer, from 100° Fahrenheit and over in the west to the nineties in the east; and from dry air all year in the west to very humid air in many parts of the east, especially near the coast. Such extreme climatic conditions within one country make for unusual economic factors in one part of the country compared with another.

The "Fuel Section" previously referred to estimates that over 34 million occupied dwelling units in the country:

37% heat with bituminous coal.
23% " wood.
13% " anthracite coal.
11% " gas.
10% " fuel oil.
4% " coke.
nearly 1% have no heat.

Also that gas serves:

Central heat to 664,159 apartment dwelling units.
" " 945,737 private dwelling units.
Space heat to 2,256,718 " "

In figures given for the Natural Gas Industry on p. 316 of the English "GAS JOURNAL" of Dec. 9, 1942, you will note that house-heating gas is included in "Domestic Sales." The reason for this was given by Major Alexander Forward, Managing Director of the American Gas Association, in a letter to the Editor on p. 343 of the March 17, 1943, issue of the "JOURNAL." He said: "In a number of our natural gas territories . . . where the climate requires only a few days' heating in a year, there are millions of small individual room heaters lighted only when the occasion requires. These are not separately metered; therefore, there cannot be comprehensive statistics on house-heating in the natural gas industry. The total number of gas-fired central house-heating installations in occupied dwellings connected to the lines of all United States gas companies in 1940 amounted to 1,108,889. In addition there were 2,724,155 occupied dwellings heated by gas-fired space heaters, floor furnaces, &c., giving a total of more than 3,833,044 occupied homes in the United States that are heated by gas, either natural or manufactured." To-day 85 million people are served with gas in the U.S.A.

The American Gas Association shows that the 1942 increase of gas for central heating in domestic and other buildings of 240 gas companies throughout the country over 1941 was 11.7%, and that the number of installations increased 18.5%; saturation of home-heating installations per 1,000 customers was 34.5, an increase over 1941 of 14.6%. Throughout the country the use of gas in industrial and commercial establishments in 1942 was 31.6% greater than in 1941.

In various large cities consumption *per capita* varied from 59 to 400 therms in 1942. Strangely enough the 400 therm figure was manufactured and not natural gas. In the British sense there is no such thing as the "all gas house" in America. But gas is used increasingly for heating and also for air-conditioning, the use for which will increase rapidly after the war, when greater attention will also be given to humidity control—a very important factor in summer and winter. Gas refrigerators are in use in large numbers and have the advantage of no moving parts. After the war they will be designed very differently, giving easier access to shelves, and including a quick freezing unit for foods to be kept a long time. Gas ranges are well designed now, but they will be further improved and may include food dehydrating units, clothes drying cupboard, &c. Many theatres (mostly cinemas) are air-conditioned in the summer, as are a large number of restaurants, offices, and railway sleeping cars.

Gas Transmission

A number of steel plants and oil refineries sell surplus gas to the Gas Industry. It is delivered distances varying from a few miles up to about 60 miles, and at pressures up to about 100 lb. per sq. in. In the past it was pumped from Fairmont, West Virginia, to Cleveland, Ohio—about 225 miles—but the latter city now has natural gas. The best known natural gas pipeline runs from Texas—Panhandle to Chicago—a 24-in. line nearly 1,000 miles long, with pumping stations at 100-mile intervals. Pressure is about 750 lb. per sq. in. As natural gas used in the industry has no smell, local ordinances in some areas require a smelling agent to be added. The gas is very dry, and often causes damage to, or plugs up, meters and orifices. Much natural gas is rehydrated with special agents to overcome this.

Organic Sulphur Removal

Most States specify a maximum of 30 grains per 100 cu.ft., and rarely is gas sent out containing more than 20 grains. Many plants do not exceed 15 grains. Research is continuing both on the part

	Great Britain. Mr. Tomlinson's figures. Year.		U.S.A. Year.	
Total coal produced	1938	227.02 million long tons	1940	450.65 million long tons
Coal consumed in country	,,	175.14 ,, ,, ,,	,,	384.6 ,, ,, ,, —Bituminous.
			,,	43.6 ,, ,, ,, —Anthracite.
			,,	428.2 ,, ,, ,, —Coal total.
Coal for electric energy, including railways and tramways	,,	14.93 ,, ,, ,,	,,	49 ,, ,, ,, —Approximate
Coal for gas and coke at gas-works	,,	18.20 ,, ,, ,,	,,	6.14 ,, ,, ,, —Bituminous.
			,,	.19 ,, ,, ,, —Anthracite.
			,,	6.43 ,, ,, ,, —Coal total.
,, for gas and coke at coke ovens	,,	19.09 ,, ,, ,,	,,	72.7 ,, ,, ,, —Bituminous.
,, for domestic use in homes	,,	40.00 ,, ,, ,,	,,	189.6 ,, ,, ,, — ,,
,, for domestic industries, public buildings, institutions and general manufacture	,,	57.74 ,, ,, ,,	,,	31.1 ,, ,, ,, —Anthracite.
,, consumed in country *per capita* population	,,	3.80 long tons	,,	3.30 long tons.
Number of families	1942	12 million.	,,	29.9 million.
,, ,, connected to gas supply	,,	10,700,000, or 90%.	,,	16,922,000, or 57%.
Total energy used in country *per capita* population for all purposes—			,,	Anthracite. 99 therms
			,,	Bituminous 857 ,,
				Total coal 956 ,,
Coal	1938	1,140 therms	,,	506 ,,
Liquid fuels	,,	100 ,,	,,	118 ,,
Natural gas			,,	56 ,,
Hydro power			,,	20 ,,
Imported oil				
Total	,,	1,240 ,, 100% 75%	,,	1,656 ,, 134% 100%

Uses of fuels in homes.	Mr. Tomlinson's figures. Year.		U.S.A. Year.	
Gas—Britain: 1,000 million therms at 50% efficiency	1942	500 million useful therms		
U.S.A.: 5,980 ,, ,, at 60% ,,			1940	3,588 million useful therms.
Solid fuel—Britain: 39 million tons. 12,000 million therms at 20% efficiency	,,	2,400 ,, ,, ,,		
U.S.A.:				
Coke 2,184 ,, ,, at 50% ,,			1940	1,092 ,, ,, ,,
Anthracite coal 8,987 ,, ,, ,, ,,			,,	4,493 ,, ,, ,,
Bituminous coal 18,340 ,, ,, at 45% ,,			,,	8,253 ,, ,, ,,
Oil 9,950 ,, ,, at 33% ,, (1940 would be more)			1939	3,283 ,, ,, ,,
Total useful therms	,,	2,900 ,, ,, ,,		20,709 ,, ,, ,,
,, ,, ,, per family		240 useful therms.		693 useful therms.
Total liquid fuel produced *per capita* population			1940	616 therms.
Liquid fuel from petroleum for home consumption	1938	2,768.3 million Imp. gall.	,,	40,548.8 million Imp. gall.
Motor spirit included in above	,,	1,463.5 ,, ,, ,,	,,	20,622 ,, ,, ,,
Plus refined motor spirit mostly from gas-works	,,	10.51 ,, ,, ,,	,,	
Electricity used in homes	1942	7,500 ,, kWh.	,,	25,308 ,, kWh.
,, ,, ,, per family	,,	625 kWh.	,,	846 kWh.
Total: Consumption *per capita* population			,,	901 ,,

of the Gas Industry as a whole and by individual contractors. The Institute of Technology in Chicago is concentrating on the identification of organic sulphur components, and on accurate apparatus and reagents for its removal. There exists plant for removal, but work is continuing in an effort to reduce cost of operation. The ultimate aim is to eliminate organic sulphur from gas, but no doubt it will be accomplished in stages as experience and knowledge are gained.

Calorific Value

Throughout the country there are many calorific values, which are controlled as to minimum by State Public Service Commissions. In the east the general values are from 510 to 540 B.Th.U. (Massachusetts, 528 B.Th.U.), whereas in the mid-west there is some mixed natural and manufactured gas, usually about 800 B.Th.U. In the south and west and odd places in the east natural gas will run about 1,000–1,100 B.Th.U.

The Smoke Problem

Little fuel is burned in open grates. An unimportant exception is the wood logs burned in living-room open fireplaces, mostly during cold winter weekends, and more for effect than warmth. Bituminous coal burned in homes is mostly used in central-heating stoves and furnaces with a very much greater efficiency than that of open grates; pulmonary diseases are negligible, as proved by health statistics. Although most American cities have steam railways running through them, this is not true of New York. For a great many years trains entering the city change to electric locomotives 20 or more miles away. On the New Haven line this is done over 70 miles away. There are one or two steam shunting engines in the city near the docks, and all but these few are electrified in and near the city. There are a few cities, such as Pittsburgh, which still have a smoke problem. It is being given much attention and considerable improvement has been achieved. But the country as a whole is relatively free from smoke.

Many New York City buildings and offices are supplied with steam for heating and hot water by the New York Steam Company, a subsidiary of the Consolidated Edison Company, which supplies gas and electricity to the metropolitan area. Whether any of this is waste-heat from gas manufacture I do not know, but such heat is used in a similar manner in other U.S. cities—a valuable contribution to modern comfort and civilization.

Future Fuel Resources

It is evident that the basic fuel resource of the U.S.A. will be coal, of which there is abundant supply. While the country has been basking in the luxury of large supplies of natural gas and oil for many years, these fuels are being exhausted quite rapidly. Wells must be drilled deeper and at greater expense. Drilling was up to 1,800 ft. in 1900, 8,000 ft. in 1926, and 13,000 ft. in 1935, and as deep as 15,000 ft. in 1938. Generally this deep drilling, which is becoming more common, is costing up to three times as much as it did less than ten years ago. Eventually an economic limit will be reached, when there will be a gradual return to the basic fuel—coal.

There are abundant oil supplies in many South American countries, and perhaps vast unexplored supplies in Alaska. The economics of transportation will effect the extent of their usage in the U.S.A.

It is universally recognized that war has put a terrific strain on the natural gas and oil supplies for use in industry. Oil is used in unprecedented quantities as motive power for ships, air planes, tanks, and other vehicles of war, to such an extent that both industry and civilians have felt shortages quite severely. While continuation of the wartime rate of use is unlikely after hostilities cease, there is expected a great increase of oil usage for airplanes. It is quite likely the U.S. Government will put in controls so that house-heating and some other present means of oil usage will be prohibited or strictly limited. At the present time all who are now using oil as a heating medium are urgently requested to convert to coal burning. Large numbers are doing this. There is considerable wastage of natural gas in carbon-black manufacture and in refining of natural gasoline. No doubt curbs will be placed on such wastage.

Electricity

Mr. Tomlinson shows that electricity used per family in Britain was 625 units in 1942. The 1940 figure for the U.S.A. was 846 units, which is only 35% in excess of British usage. Throughout the U.S.A., consumption *per capita* was 901 kWh., at an average cost of 2.06 cents. There appears to be an erroneous assumption that large American cities use vast quantities of electricity *per capita*. Strangely enough, consumption per customer in urban areas for home use was 935 kWh. in 1940 and 1,022 kWh. in 1942, which is much less than rural consumption. The Edison Electric Institute points out that consumption in large cities is less than these figures—not more. This is due to the existence of large apartment houses, many of which rent one-room apartments. No detailed figures are available.

In 1940 rural consumption per domestic consumer was 2,902 kWh., which is three times as much as for the urban dweller. Some of this is used for pumping water for irrigation, &c.

In the generation of electricity by fuel, consumption was 1.35 lb. of coal equivalent per kWh. Modern generating plants use 0.8 lb. in steam boilers and 0.75 lb. in mercury boilers. Good steam boiler efficiencies are 82–84%.

In the American Gas Association *Monthly* for December, 1942, Mr. T. J. Shanley, has given the following figures of fuels used for cooking in occupied dwellings in 1940:

Dwellings reported.		Coal or coke.	Wood.	Gas.	Elec.	Kerosene or gasolene.	Other.	None.
		%	%	%	%	%	%	%
Urban	20,291,512	8.0	6.0	73.0	5.1	6.9	0.4	0.5
Rural non-farm	7,050,541	19.1	28.6	24.0	8.7	18.6	0.6	0.4
Rural farm	7,001,144	14.1	69.5	3.8	2.7	9.0	0.8	0.1
Total	34,343,197	11.5	23.6	48.8	5.4	9.7	0.5	0.4

Urban areas are those with 2,500 or more population.

Gas is used for cooking in nine houses for each one house using electricity for that purpose. In only five States is electricity ahead of gas in this respect in urban areas, and those States have much hydro-electric power, gas not being readily available.

In urban areas 95% have electricity for lighting homes, and 77.8% have it in rural non-farm areas. Gas as such is not used for home lighting.

SALES IN MILLION CUBIC FEET.

Year.	Manufactured gas.	% Increase over previous year.	Natural gas.	% Increase over previous year.
1939	360,318	3.96%	1,330,664	9.71%
1940	389,634	8.14%	1,441,692	8.34%
1941	405,427	4.05%	1,602,634	11.16%
1942	441,335	8.86%	1,771,035	10.51%
1939-42	—	22.48%	—	33.09%

For the same period, 1939–1942, electric sales increased 43%.

Everyone was asked to economize in the use of fuel in 1942. In some manufactured and natural gas areas certain customers were actually cut off for short periods, due either to shortage of oil for water-gas making or to peak-demand shortages of natural gas. This was probably not so of the electric industry, especially in areas supplied from hydro-plants.

So for the year 1940 we have 935 kWh. per urban domestic consumer and 2,902 kWh. per rural domestic consumer. Manufactured gas per domestic consumer was 21,133 cu.ft., excluding house-heating. Similarly natural gas was 58,171 cu.ft., which included house-heating, in this instance inseparable. The total consumption *per capita* served was 8,050 cu.ft. for manufactured gas and 41,150 cu.ft. for natural gas. The figure for manufactured gas is approximately the same as the British figure, but there is nothing in Britain with which to compare natural gas.

It is hoped these notes will prove of some interest as a sidelight on American conditions compared with those in Britain as outlined by Mr. Tomlinson.

Wales Juniors

The Annual and Opening Meetings of the Wales and Monmouthshire Junior Gas Association were held on Aug. 21 at Neath. The chair at the annual meeting was taken by Mr. R. T. Mills, who called on Mr. W. Clark Jackson, Engineer and Manager of the Neath Corporation Gas Department, who welcomed the Association.

The following officers were elected for the 1943–44 Session on the motion of Mr. C. E. Banham, seconded by Mr. P. J. Wride:

President.—Darrell W. Rees, M.B.E., Pembroke.
Senior Vice-President.—W. R. Branson, Cardiff.
Junior Vice-President.—K. M. Ernest, Cardiff.
Hon. Librarian.—H. S. Bartlett, Cardiff.
Hon. Treasurer.—B. J. Bell, Cardiff.
Hon. Auditors.—T. Noall and C. E. Banham, Cardiff.
Hon. Secretary.—K. M. Ernest, Cardiff.

The President presented the Council's Report for the 1939–43 Session. This was adopted on the motion of Mr. W. R. Branson, seconded by Mr. D. E. West.

In the absence of the Treasurer, Mr. B. J. Bell, the balance sheet was presented by Mr. C. E. Banham. Its adoption was moved by Mr. W. J. Viney, and seconded by Mr. J. H. Chapman.

At the Opening Meeting Mr. W. D. Rees gave his Presidential Address, and a vote of thanks was accorded him on the motion of Mr. W. R. Branson, seconded by Mr. J. H. Chapman.

Before presenting Mr. R. T. Mills with a Past-President's Certificate the new President congratulated him on carrying through his duties in such an efficient manner.

The meeting ended by the President according a vote of thanks to Mr. Jackson. This was seconded by Mr. K. M. Ernest, who spoke highly of Mr. Jackson's work on behalf of the Juniors.

RATIONAL PREPARATION OF COAL*

By R. LESSING

(*Continued from p. 428*)

The conditions to be fulfilled by a suitable plant are that the dedusted coal can be accurately separated into three fractions of specific gravity ranges appropriate to the particular coal, for example, bright coal below 1.35, dull coal and middlings from 1.35 to 1.6, and mineral refuse above 1.6. The accuracy of separation should be such that, say, 95% of each fraction should fall within the appropriate range on testing a representative sample by the float-and-sink method. Such a separation can be attained in commercial practice, at any rate with salt solutions.

Bright Component

For some time apprehension has been expressed that the reserves in this country of good gas and coking coals are seriously diminishing. There should be no anxiety on this score if the bright coal component is separated from all seams, and that portion of it which is of suitable rank is diverted to the gas and coking industries. There is ample material of the right kind dispersed in seams, which in their totality would be quite unsuited to this purpose. As probably less than one-fifth of the output of all bright coal will satisfy the demands of the carbonizing industries, a relatively narrow range of the bright variety will meet these requirements even if, as it is hoped by some, carbonization both at high and low temperatures will experience a large expansion in the future.

The selection of bright coal according to rank will permit the allocation of coals of closely specified properties, such as caking, agglutinating or swelling values and yield of gaseous therms, to coke ovens and gas-works plant of varying kind, vertical retorts, intermittent chambers, or horizontal retorts, according to the specific requirements of each type of plant.

A common feature of bright coal, whatever its rank, is its low ash content. If properly prepared this may in some cases be less than 2%, and should not exceed 3%. The effect of using coal prepared in this manner has been demonstrated in large-scale tests in the Willoughby Lane Works of the Tottenham and District Gas Company.

Several hundred tons of the bright component from a Yorkshire coal were prepared by dedusting and gravity separation in calcium chloride solution, yielding 6.3% of dust, 79.4% of clean coal, and 14.3% of dull coal and refuse. The clean coal was carbonized in continuous vertical retorts side by side with a corresponding quantity of the coal which had served as the raw material, and which was at that time regarded as a good gas coal. The two coals had the following properties:

TABLE I.

		Original coal.	Clean coal. (bright).
Screen analysis:		%	%
Through 2 in.	On 1 in.	1.5	1.9
1 ,,	½ ,,	25.9	30.3
½ ,,	⅜ ,,	11.0	12.8
⅜ ,,	¼ ,,	19.1	21.8
¼ ,,	5 IMM.	14.9	15.2
5 IMM.	10 ,,	10.3	9.2
10 ,,	20 ,,	6.5	5.2
20 ,,	50 ,,	4.6	2.5
50 ,,	100 ,,	2.4	0.5
100 ,,	200 ,,	2.0	0.2
200 ,,		1.8	0.4
		100.0	100.0
Proximate analysis:		%	%
Free moisture		1.2*	5.6†
Inherent moisture		4.27	4.34
Volatile matter		33.31	35.79
Ash		8.01	1.66
Chloride		0.173	0.090

* As charged to gas retorts.
† As discharged from drains at colliery.

The results recorded in Table II were obtained from the examination of the coke made from both coals.

TABLE II.

Grade.	Screen size.		Coke from original coal.		Coke from clean (bright) coal.	
	Through	On	Yield.	Ash.	Yield.	Ash.
			%	%	%	%
I	2 in.	1½ ,,	38.3	7.91	57.2	3.15
II	1½ ,,	½ ,,	26.9	9.55	24.5	2.93
III	½ ,,		19.9	16.19	10.8	3.18
Breeze			14.9	25.78	7.5	3.63
Total coke			100.0	12.78	100.0	3.13

Two important facts become manifest from these results. First, the percentage of large coke from clean coal is greatly increased, while

* From a Paper to the Institute of Fuel, Sept. 30.

the percentage of breeze is halved; secondly, while the ash content of the coke from original coal rises with decreasing size to nearly 26% in the breeze, the ash in the four grades from clean coal remains constant throughout at the remarkably low average figure of 3.1%. The obvious inference is that the clean "breeze" cannot be regarded as a low-grade fuel, and that on account of its negligible ash content it can be put to uses, in spite of its size, for which ordinary breeze could never be considered. The total revenue from coke is therefore greatly enhanced by reason of total yields quite apart from its higher fuel value.

The coke from clean coal was strikingly superior to that from the original coal in appearance, hardness, density, fissuring and cleanliness to the touch. Tests at the Fuel Research Station proved it to have a considerably higher maximum rate of radiation than the coke from the original coal which was found quite unsatisfactory in a well-type grate. The convenience of maintaining a domestic boiler alight for nine months, the total absence of clinker and the small amount of ash collected seemed to put the clean coke into a class by itself.

The behaviour of the two cokes in a water gas plant was ascertained in comprehensive tests, as shown in Table III.

These figures speak for themselves and show the great improvements when using clean coke, in rate of gas and therm production, composition of gas, steam consumption, time of clinkering, and carbon content of clinker.

The advantages of clean and dust-free bright coal in gas and coke making are not confined to the quality of the solid product, nor are they merely expressed as a reduction of ash in coke corresponding to the lower ash in coal. The operational improvements realizable in carbonizing practice are not of less importance. These comprise a definite speeding up of the process.

The explanation of this remarkable difference in behaviour is that the fine and porous dust attached to the surfaces of the coal particles absorbs the tar and pitch which clog the interstices, eventually become carbonized, and thus impede the free passage of the gas and particularly of further tar vapours. In the absence of such dust and of the finer refuse, the gas sweeps freely past the smooth coal surfaces, and thus allows the crude gas to disengage itself more rapidly. The crude tar vapours are quickly removed and are therefore less subjected to secondary thermal decomposition. Furthermore, free play is given to the fusing and merging together of the clean surfaces of adjacent particles free from dust and clay film, a factor which largely accounts for the higher quality of coke produced from clean coal.

TABLE III.—Carburetted Water Gas Tests.

	Coke from original coal.	Coke from clean (bright) coal.
Gas made per hour, cu.ft.	24,600	30,100
,, ,, therms	105.5	138.0
Gas made per lb. of coke, cu.ft.	30.3	30.2
,, ,, ,, therms	0.131	0.140
Coke used per 1,000 cu.ft. of gas, lb.	32.8	33.0
Oil used per 1,000 cu.ft. of gas, gall.	1.69	1.78
Steam to generator per 1,000 cu.ft. of gas, lb.	40.8	29.5
Clinkering time per 24 hr., min.	118	61
Clinker, per cent. of coke used	8.2	1.2
Pan ash, ,, ,,	7.3	1.7
Analytical results—		
Coke—		
Moisture, %	1.0	1.1
Ash, %	7.9	3.4
Clinker—		
Moisture, %	1.5	2.3
Ash, %	83.2	98.2
Pan ash—		
Moisture, %	9.1	2.1
Ash, %	69.2	62.4
Purified gas—		
CO_2 %	8.8	5.3
O_2 %	1.3	0.2
C_nH_m %	4.9	5.4
CO %	27.5	35.4
H_2 %	39.4	40.1
CH_4 %	10.1	10.7
N_2 residual, %	7.1	2.9
Percentage	99.1	100.0
Calorific value (calc. from analysis), B.Th.U. per cu.ft.	428	475
Calorific value (Boys calorimeter), B.Th.U. per cu.ft.	424	463

To avoid excessive intumescence, coals prone to this phenomenon should be blended with the bright component of non-swelling coals to ensure a free passage of gas and coke through vertical retorts. This admixture is preferable to high-ash dull coal or mineral matter being left in the original coal.

The increase in rate of throughput obtainable with suitably prepared coal has a great bearing on the carbonizing capacity of existing gas-works plant, and should go a long way to ease the problems of gas supply in the immediate post-war world.

All the arguments advanced in connexion with gas-works practice apply with equal force to low-temperature carbonization. A very low ash content implying cleanliness and convenience indoors, is a greater inducement to the householder to adopt this fuel than the moral conviction that he contributes to the health and comfort of his neighbours and the community by abating atmospheric pollution.

The considerations of the use of individual coal components in the carbonizing process apply to hydrogenation with equal or even greater force, since coal and coal components differ widely in their susceptibility to the addition of hydrogen under pressure. The pioneer plant at Billingham is in a fortunate position. The coal submitted there to hydrogenation is only a relatively small portion of the total tonnage consumed in that very large works under boilers, in coke-ovens, gas-producers and furnaces. It is therefore possible to extract the component most suitable for hydrogenation from the bulk and pass the balance to the other uses; a good example of the subdivision now proposed as a routine measure.

Brief reference must be made to oil-coal mixtures, often inaptly referred to as colloidal fuel. This is a case which clearly calls for freedom from ash and rigid selection, if the advantages of liquid fuel are not to be impaired unduly by the admixture of coal. The coal must be entirely free from shale and pyrites, which would cause abrasion in burner nozzles if fired directly, or of cylinders and piston rings if used in internal-combustion engines. The coal components selected must be amenable to surface reactions with the oil used so that permanent suspensions can be obtained.

The influence of ash in coal carbonized in ovens for the production of metallurgical coke is clearly shown by the trend of fuel consumption in British blast furnaces and steel works. A long period of indifferent efficiency, marked by high coke consumption and low output from 1885 to 1918, was followed by a sharp deterioration in the immediate post-war years, due to poor coke quality. In 1929 particularly, coke quality was extremely bad; it was high in ash and moisture content and had a low physical strength. Since 1924, when the Fuel Economy Department of the Iron and Steel Federation was formed and began to exert a forceful influence on the improvement of coke quality, a steady reduction in fuel consumption per ton of pig iron from 40.9 cwt. in 1924 to 32.6 cwt. in 1936 was achieved, coupled with an increase in annual output per furnace from 40,000 to 65,000 tons.

Economic Considerations

The economics of the practical application of the plan outlined are of a magnitude which excludes their detailed discussion from the purview of this Paper. It may, however, be permissible, again in an admittedly over-simplified form, to indicate the values involved.

In 1938 the proportion of cleaned saleable coal produced was 45.4% of the total coal output of Great Britain. In most of the 804 cleaning plants then in use the efficacy of the treatment did not comply with the full requirements of the proposed scheme, so that preparation facilities for more than the remaining 55% of the output will have to be provided.

Moreover, the comprehensiveness of the suggested treatment will necessitate the substitution of new plant for some of that in existence, which is generally designed and operated for the treatment of selected sizes.

Let us therefore consider the treatment of a round 100 million tons—rather less than half the output in 1938.

The cost of modern cleaning plant, including dedusting equipment, may be taken as £350 per ton per hour. On this basis, when working 2 shifts of 8 hours per day and 550 shifts per year, a capital outlay of £8,000,000 would be required, equivalent to 1s. 7d. per ton of annual throughput. This will be spread over 60 to 100 plants of reasonable capacity attached to large collieries or located in central positions.

The operating cost, including capital charges, should not exceed 9d. per ton of coal treated, or a total of £3,750,000 in respect of the 100 million tons.

On the credit side the technical advantages cannot be ascertained until experience has been gained with separated coal components in the commercial operation, say, of a gas-works and a boiler plant.

Some monetary advantages of ash reduction can, however, be assessed fairly accurately. Waite estimated the potential saving in respect of 60 million tons of coal consumed in power stations at £3,674,000.

My calculations showed a possible saving in gas-works of more than 2s. per ton. This, applied to, say, 10 million tons of gas coal only, amounts to over £1,000,000.

The Report on Fuel Saving in the Iron and Steel Industry suggests that the efficient cleaning of coking coal and the consequent production of cleaner coke will result in economies of fuel in the blast furnaces of the North-East coast of the order of 10%. Assuming this to be applicable to the whole production of metallurgical coke in the country and the cost of raw coal to be 20s. per ton, it would amount to an annual saving of about £2,000,000.

Ten Per Cent. of the oil used by Glasgow Corporation Transport Department is supplied by the City's Gas Undertaking, said Mr. E. R. L. Fitzpayne, General Manager of the Transport Department, when he addressed the Publicity Club of Glasgow on Oct. 8. They obtained most of their oil from the Scottish shale fields, said Mr. Fitzpayne, but they also mixed with this a proportion of creosote oil produced at the Glasgow Gas-Works. They were now using 3,000 gallons of creosote oil per week.

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INCREASING GAS-WORKS EFFICIENCY*

By A. C. REA, M.I.Mech.E., Assistant Engineer and Manager, Bath Gas Company

BY reason of the restricted labour available and lack of choice of raw materials, due to wartime conditions, general efficiency in gas manufacture has been affected. It is therefore necessary to examine all possible means whereby the standard of works efficiency can be increased, so that the best use may be made of the labour and material available. This increase may be obtained by the installation of more efficient plant and the substitution of mechanical plant in place of manual labour.

A rapidly expanding gas output calls for an increased quantity of steam, and it is the fortunate works which has boiler plant available to meet this demand. One solution which is open to many works is the installation of waste heat boilers. We have four of these recovering the waste heat from our horizontal retort settings. The inlet flue gas temperatures are recorded on two Cambridge double pen pyrometers, and average about 450°/500°C. The maximum evaporation with all four boilers in full operation is 2,000,000 lb. of steam per week, but the actual increase in effective steam added to the works system is about half this amount, due to the steam required for the fan engines, and allowing for settings not in use. At peak loads the basic steam load is taken by five or six of the seven Lancashire boilers, allowing one off each set for cleaning. These can evaporate 4,000,000 lb. of steam per week, using unscreened breeze. The actual evaporation is 6.5 lb. of water per lb. of breeze. The installation of waste heat boilers on the coal gas plant therefore provides approximately 20% of our total steaming capacity.

The cost of softened boiler feed water, including capital charges, is calculated at 8d. per 1,000 gallons. The cost of steam raising in one set of four Lancashire boilers is 20d. per 1,000 lb.; in a set of three Lancashire boilers 16d. per 1,000 lb.; in four waste heat boilers 10d. per 1,000 lb. available.

The average cost of all steam raised on the works is 16d. per 1,000 lb. All costs include both running and capital charges.

The cost of steam depends on the price at which breeze is charged to the boiler plant. The price at which the surplus breeze is sold is not a fair figure, as this price could not be obtained if the whole of the breeze made had to be sold. These costs are based on unscreened breeze at 15s. per ton.

The Bath gas-works are self-supporting as far as power requirements are concerned. Electric motors or steam engines are used for all power purposes, the electricity being steam generated.

The total steam requirements of our three hand-operated C.W.G. sets is about 10,000 lb./hr. Maintenance of full steam pressure is necessary to ensure maximum gas output, and this requires sufficient boiler plant for peak demands. In No. 4 C.W.G. plant the installation of a generator boiler and waste heat boiler has been included, thus making the plant almost self-supporting in steam.

Pre-heating of boiler feed water can materially help evaporation per lb. of fuel, and in our boiler plants the gas condenser cooling water is used, being further heated by the exhaust steam from the turbines by means of tray type heaters feeding the water-softening plants, so that the temperature of the feed water to the boilers is raised to approximately 140°F. The feed water to the waste heat boilers is further heated by utilizing the exhaust from the fan engines in pre-heaters to raise the temperature to 180°F. An economizer is fitted to one set of Lancashire boilers and raises the feed water temperature to about 220°F.

Three water-softening plants are now in use with a capacity of 5,200 gall./hr. It is essential that they should be capable of softening the absolute peak flow, if the interiors of the boilers are to be kept free from excessive scale and sludge.

To minimize the loss of pressure in transmission ample sized steam mains are necessary, and the three sets of boilers are interconnected by 6-in. mains, with suitable isolating valves. Proper lagging is essential to reduce condensation losses, and inspection and maintenance of steam traps to avoid loss of steam. The exhaust steam not used for pre-heating feed water is passed into steam jet condensers which operate at a vacuum of 22–26 in. Hg. This, besides avoiding the unsightliness of steam issuing to the atmosphere, reduces steam consumption by about 15 to 20%.

As our annual boiler fuel consumption is about 10,000 tons the economies effected by the above are substantial, and savings which can be effected in this way will assist the present fuel problem, and improve the Fuel Expenditure Index. Attention to the steam nozzles of the forced draught jets below the breeze-burning grates of Lancashire boilers can save quite an appreciable amount of fuel.

Electrostatic detarrers have been installed on both the coal gas and the water gas streams, the units being independent though similar in all respects, excepting that the coal gas plant is designed to pass up to 8 million cu.ft. per day, and the C.W.G. plant 5 million cu.ft. per day. Their efficiency as tar removers is, within experimental error, 100%.

On the coal gas stream the detarrer is situated after the exhauster and prior to the existing Livesey washers, which have been retained to perform their original function, should a stoppage of the electrostatic plant occur, whether voluntarily for periodic cleaning, or otherwise.

The effect of efficient tar removal on the wet and dry purification plants has been to increase their efficiency and capacity to a marked degree. Prior to the installation of the detarrer the brushes in the rotary ammonia scrubbers became clogged with tar. Since putting the detarrer to work we have renewed the brushes, and the bristles are now free from tar, and can therefore give a more intimate contact between gas and liquor.

Since the installation of the electrostatic detarrers, back-pressure troubles with oxide boxes have been greatly reduced, and the oxide can be worked up to a higher percentage. New oxide has been worked up to 40% sulphur on the first fouling, and to 60% before sale. Excessive hardness is being experienced with the artificial oxides now being used, even on their first fouling. Pneumatic compressor tools are sometimes used to help break up the oxide before emptying. The hard oxide has called for a powerful breaker for revivification, and a 10 h.p. machine is now used.

Efficiency, in a wider sense of the word, is under general consideration by the Industry at the present time, and careful plans are being framed for the proposed grouping of undertakings where their geographical situation would allow of linking together. About 13 years ago the Bath Gas Company prepared a scheme for the acquisition of several small neighbouring undertakings, the object being to close down these small and uneconomic works, and supply their areas from the Bath works. Up to the outbreak of war four company-owned undertakings and one municipally-owned undertaking had been absorbed. The proof of the success of this policy is shown by the benefits received by the consumers of these small undertakings in the form of substantial reductions in the price of gas and an improved service, and these factors have led to large increases in the sale of gas in these areas, resulting in a benefit to the Bath consumers by a reduction in the overheads.

The following table shows the date each undertaking was absorbed, the annual sales of gas at the date of acquisition, and the present annual sales:

Undertaking.	Date of acquisition.	Annual sales of gas at date of acquisition, million cu.ft.	Present annual sales of gas, million cu.ft.
A	Dec., 1932	55	168
B	,, 1932	10	54
C	July, 1936	42	85
D	Jan., 1937	91	236
E	Apr., 1939	30	46
Villages supplied en route		...	33
		228	622

It will be seen that the total increase in the annual sales amounts to 394 million cu.ft., or 173%, including 33 million cu.ft. per annum supplied to just over 1,000 consumers in rural areas who otherwise would not have had the benefit of a gas supply. A further point is that it is highly improbable that some of these undertakings would have been able to meet the wartime demands which have arisen in these areas.

The possibilities of increasing the sales of gas by absorption, as described above, are shown by the fact that whereas the average annual rate of increase in output of the five undertakings prior to absorption was about 2%, the average annual rate of increase in these areas since absorption is about 22%. In each area taken over an immediate reduction in the price of gas was made, and a sliding scale of charges introduced, whereby consumers who increased their consumptions received still further reductions. As the total sales of gas increased, it was possible to reduce the scale of charges still further.

The table below shows the average price received per therm of gas sold in the various areas (*a*) prior to acquisition, (*b*) for the year 1939, and (*c*) to-day:

Undertaking.	Prior to acquisition.	Year 1939.	Reduction.	To-day.
A ...	10.24	8.4	1.84	10.0
B ...	12.02	8.8	3.22	9.6
C ...	11.00	8.7	2.30	10.3
D ...	10.61	8.1	2.51	9.2
E ...	12.61	10.5	2.11	11.6
Bath Inner Area ...	1933: 5.38	5.49	—	8.46

It will be seen that up to the end of 1939 the reductions enjoyed by the consumers in the areas taken over varied from 1.84d. to 3.22d. per therm.

Owing to the war the average price in the Bath Inner Area has been increased by 2.97d. per therm, but this increase has not been passed on in full to the new areas, the increase varying from 0.8d. to 1.6d. per therm.

To supply this additional gas demand, a considerable amount of main laying has been carried out, and new compressing plant installed. The most recent sets are for 300,000 cu.ft. per hour at 12 lb./sq.in., and are driven by compound V type high-efficiency steam engines. An additional booster of 1¼ million cu.ft. per hour, electrically-driven, to assist the low-pressure system has also been installed. This gives an increase of 12 in. to the holder pressure and allows all works holders to be fully utilized on the districts.

* From a Paper given to the Western Junior Gas Association, Sept. 25.

Gas Products Prices

The London Market Oct. 11.

All Coal Tar Products are in good demand, and Pitch in the London area remains about 45s.

An Order entitled The Control of Toluene (No. 3) Order, 1943 (S. R. & O. 1943, No. 976), came into force on July 20, and introduced certain changes in the prices for different grades of Toluene.

There is nothing of interest to report regarding Coal Tar Products, except that there is official tightening up of the purposes for which Refined Coal Tar may be supplied.

The Provinces Oct. 11.

The average prices of gas-works products during the week were: Pitch and Crude Tar,* Toluole, naked, North, 90's, 1s. 11d., pure, 2s. 7½d. (controlled by the Control of Toluene No. 3 Order, 1943, dated July 14, operative from July 20, 1943). Naphtha and Xylole controlled by the Coal Tar Naphtha and Xylole Order, 1943, dated May 31 (S. R. & O., 1943, No. 768), operative from June 1. Carbolic acid, 60's, naphthalene, and anthracene controlled by the Coal Tar Products Prices Order S. R. & O. 2509, dated Dec. 7, 1942, and operative from Jan. 1, 1943. Filtered heavy oil (min. gr. 1,080), 7½d. to 8d. Creosote oil has been generally controlled as to direction and price for some time past. Current value—fuel grades 5d. to 5½d.; timber preservation and other purposes 4¾d. to 6d.

* In regard to pitch and crude tar prices we would ask readers to refer to the editorial note on p. 396 of the "JOURNAL" for Sept. 10, 1941.

Tar Products in Scotland Oct. 9.

Deliveries continue on a large scale. Refined tar controlled. Value is 4½d. per gallon *ex* Works, naked. Creosote oil: Specification oil, 6½d. to 7d.; low gravity, 7½d. to 7¾d.; neutral oil, 6d. to 6½d.; hydrogenation oil, 5¾d. per gallon; all *ex* Works in bulk. Refined cresylic acid is in good call at 3s. 6d. to 4s. 6d. per gallon *ex* Works, naked, according to quality. Crude naphtha; 6½d. to 7d. per gallon. Solvent naphtha: Basic prices delivered in bulk, 90/160 grade, 2s. 8d., and 90/190 Heavy naphtha, Unrectified, 1s. 10½d.; Rectified, 2s. 3d. per gallon. Pyridine; 90/160 grade 13s., and 90/140 grade, 15s. per gallon.

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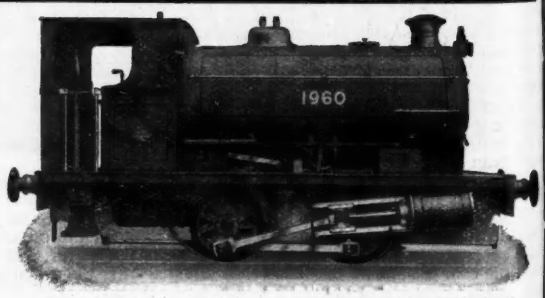
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